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Briefing note on Blockchain for the United Nations Sustainable Development Goals

Note by the secretariat

Summary

The 2030 Agenda for Sustainable Development with its seventeen Sustainable Development Goals (SDGs), adopted by the United Nations General Assembly in 2015, will guide the work of the United Nations and its Member States over the coming years. This briefing note discusses the possible contributions that blockchain, an emerging innovative technology, is making or could make to advance the achievement of the SDGs.

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I. Agenda 2030: SDGs and Blockchain

1. The 2030 Agenda for Sustainable Development (Agenda 2030), with its 17 Sustainable Development Goals (SDGs) was adopted by world leaders in September 2015, and came officially into force on 1 January 2016. Over the coming years, based upon these new universal Goals, countries will mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind (A/RES/70/1)[1]. The SDGs are a key reference point for all development actions and, particularly, those undertaken by the United Nations, including the United Nations Economic Commission for Europe, and its Centre for Trade Facilitation and e-Business, UN/CEFACT[2].

2. Agenda 2030 puts great emphasis on the role that trade and innovation can play in support of sustainable development. An important emerging innovation that has been in the news often during the last two years is blockchain technology. This briefing note examines the possible contributions that blockchain could make to the achievement of the SDGs. In particular, it explores the possible implications for the facilitation of trade transactions and access to global value chains, especially for small businesses in developing and transition economies, as well as for the provision of effective government services that support more inclusive economic and social progress.

II. Blockchain: a brief introduction

3. Blockchain is a rapidly evolving area of information technology with the potential for creating huge benefits in terms of security, reliability and cost efficiency in the exchange of information. It is essentially a cryptographic protocol which cannot be easily falsified or corrupted, enabling participants to take part in trusted transactions. In effect, the blockchain technology creates "original" electronic records which cannot be copied or altered. For this reason, blockchain is also referred to as "Distributed Ledger Technology" (DLT) because in accounting ledgers, entries cannot be altered (they can only be corrected by new entries). It is called "distributed" because the data in a blockchain is recorded and stored on a decentralized and geographically distributed network of nodes, which is updated in a coordinated way. Each node (and many blockchains have thousands) keeps a complete copy of the blockchain and it is this multiplication of copies, together with the cryptography used, which ensures that records, once they are added to the ledger, cannot be altered[3].

4. Records can be accessed for reading as often as needed, but can only be written once. They are added onto the ledger in the form of sequenced blocks, hence the name 'blockchain'. Each block contains a set of data and a unique cryptographic "fingerprint", known as a hash, and it is possible to easily confirm, through the hash, the validity of the block. If the contents of a block are in any way modified, the hash of that block will change, altering all the hashes in subsequent blocks throughout the chain and, therefore, making the change very easy to detect.

5. In order for a block to be added onto the blockchain there is a need for consensus. Consensus refers to the validation mechanism (based on algorithms), by which all nodes in

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[1] For more see: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

[2] For more see: https://www.unece.org/cefact/

[3] For more see: UNECE White Paper on Technical Application of Blockchain to United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT) Deliverables

the network verify the content of a block and agree to its addition to the blockchain. This mechanism enables participants to trust the information on the blockchain. There are several consensus algorithms depending on the type of blockchain system being used. There are also different types of blockchain systems defined by who can participate in the validation of the transactions and who can read the information on the chain. Blockchains may be either public (or "permissionless") or private ("permissioned").

III. Blockchain applications: relevance for the Agenda 2030

6. Originally, the blockchain's primary use was to store and track cryptocurrency transactions (e.g. Bitcoin). However, other uses and implementations have emerged in recent years. Some of these can be used to support the SDGs. Some blockchain applications which are already being used to support the SDGs include: the establishment of identities (for example for refugees), the tracking of information linked to identities (related to health, social benefits, etc), the distribution of resources, the tracing of goods and their content/original source, etc. The remainder of this paper looks at these opportunities in greater detail. Examples include both actual implementation as well as proof of concept (trial implementation) and emerging ideas. The selection is based on a strong foundation of tested and validated applications, without losing sight of promising future developments.

7. These examples were selected to show the possibilities that exist for using blockchain to support the SDGs. The inclusion of an example does not imply any endorsement of the quality or fitness of that application for supporting the SDGs.

A. SDG 1: No Poverty - End poverty in all its forms everywhere

8. Access to financial services for the unbanked population around the world remains essential in the fight against poverty. According to the Global Findex database 2014, around 2 billion people still have no access to financial services so, therefore, targeting financial inclusion is a necessary first step in order to raise people's living standards. It enables greater saving possibilities, access to buying property and to starting a business. SDG target 1.4 specifically mentions the need to ensure that all men and women, the poor and the vulnerable, have equal access to appropriate new technology and financial services, including microfinance. Target 1.A refers to the need to ensure mobilization of resources in order to provide adequate means for developing countries to implement programmes to end poverty.

9. While a great portion of the world population may not have bank accounts, mobile phone use has increased dramatically, even in countries with a high degree of financial exclusion, and these can be useful devices in the fight against poverty. Blockchain applications can be developed for use with mobile devices. The World Bank has supported Kenya in the development of a mobile phone-based bond issuance project called 'M-Akiba', which will assess the use of Blockchain technology to simplify the platforms used for the issuance and sale of bonds. 'M-Akiba' will allow users to purchase government bonds in very small amounts, without the need for a bank account, with transactions ranging from US$30 to US$140. The pilot phase of this mobile-only government bond platform was launched in March 2017, for US$1.5 million. After the first week of the pilot launch, 40,000 users had registered on the platform. When the final platform is launched it is estimated it will support US$50 million in bonds.

10. Access to credit is another field in which blockchain can contribute to the targets under SDG 1. An ethical investment platform is being implemented by Ethic Hub, where investors have access to '*highly-profitable positive impact projects*' and connect with small

unbanked producers. This is done through an international crowd lending platform that connects unbanked populations, which often engage in paying high interests to lenders (mostly small farmers) with socially responsible investors using blockchain. Another example, involving universal access to credit is being fostered by Credit Dream, in Brazil, which is developing blockchain based decentralized applications looking to connect investors and borrowers at lower rates and higher returns than could be obtained through banks or other, existing, credit institutions.

B. SDG 2: Zero Hunger – End hunger, achieve food security and improve nutrition and promote sustainable agriculture

11. Cutting-edge blockchain technology is being implemented in Jordan as a way of making cash-based transfers fast, secure and less costly. The United Nations World Food Programme (WFP) is working extensively to provide refugees from the Syrian conflict with an effective way to pay for their food in the refugee camps. The pilot of this implementation, 'Building blocks', was conducted in Jordan's Azraq Camp, where 10,000 refugees have now the means to pay for their food through a blockchain-based system. This system uses biometric registration data for authentication. The data is provided by the United Nations High Commissioner for Refugees and it enables refugees to buy at local supermarkets using eye-scanning technology instead of cash or card payments. In WFP's view, this lowers the possibility of fraud and the costly intervention of third-parties such as banks, *it also allows to better beneficiary data and better control of financial risks and a more rapid response in the wake of emergencies.* The WPF is now working to scale up the application and is also working on developing additional new approaches based on blockchain at their Innovation Accelerator in Munich. These efforts are expected to contribute to the achievement of SDG 2 in the near future, and particularly target 2.1 aiming at ensuring access by all people, in particular the poor and vulnerable to safe, nutritious and sufficient food.

C. SDG 3: Good Health and Well-Being - Ensure healthy lives and promote well-being for all at all ages

12. Promoting good health and well-being concerns several SDGs, and there are blockchain applications being developed within the healthcare field that contribute to achieving specific targets under SDG 3, mostly related to access to healthcare services for everyone and private, and secure storage of patient information under target 3.8. Since 2000, impressive advancements have been made on many healthcare fronts. However, to meet the SDGs health targets by 2030, progress must be accelerated, in particular in regions with the highest burden of disease.

13. The Russian Ministry of Health together with the Vnesheconombank have launched, in August 2017, a pilot for a blockchain application that explores how to exchange patient history in order to foster modernized interagency information-sharing systems. Blockchain technology can provide the basis for a quality platform for patient information to be stored in a secure way, yet enabling fast and transparent information-sharing between entities, and facilitating more effective health treatments.

14. Similarly, the United States Department of Health and Human Services is actively developing the use of trial blockchain applications. The aim is to develop a new healthcare IT system that allows interoperability and secure storage of electronic patient records, and the creation of formats that can be widely standardized and used by all stakeholders in the health community. In July 2016, the first government request for white papers related to this technology and healthcare was made and in response received 77 submissions. The

Office of the National Coordinator (ONC) for Health IT organized then a Blockchain in Healthcare coding event where the winning application was the 'Health Passport' a decentralized personal health record that enables patients to have possession of their own records. This allows them to store lifelong health-related information and share it with any provider in the world at the time of need. Furthermore, the Medical Society of Delaware, in partnership with tech startup Medscient, are building a proof-of-concept to deliver more efficient, faster pre-authorization processes for care providers and insurers; and the Illinois Blockchain Initiative is working together with Hashed Health on an application aimed at issuing and tracking medical licenses, to ensure a transparent and unique blockchain of records for both healthcare providers and patients.

D. SDG 7: Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy for all

15. To ensure universal access to affordable, reliable and modern energy services, as stated in target 7.1, much is said about the constraints of the current energy grids with regard to optimization and distribution. On one hand, energy is the dominant contributor to climate change, accounting for around 60 % of total global CO_2 emissions. On the other hand, almost 27% of the world's population living in rural areas still have no access to electricity. The United Nations Environment Programme has awarded a Asia-Pacific Low Carbon Lifestyles Challenge prize to Energo, an energy trading platform using blockchain technology and smart metres, connecting energy producers with consumers in microgrids. The tools consist both of a Smart Metre and an application, allowing individuals to set identities for their home, company or car on the blockchain network. For example, solar panel owners could share their electricity excess with other users nearby, in exchange gaining an additional source of income. The first pilot is now being tested at the De La Salle University Campus in the Philippines and is expected to generate savings of around 1.2 million Philippine pesos over the next 20 years. Microgrids and peer-to-peer energy exchange can contribute both to the reduction of CO_2 emissions as well as to ensuring access to energy systems to all.

16. There are several other examples of projects exploring the possibilities of microgrids and peer-to-peer energy exchange based on blockchain technology. For instance, an energy marketplace where clean energy is bought and sold autonomously from neighbour to neighbour, but also prioritized to critical facilities during natural disasters and outages is being developed by LO3Energy, through their Exergy blockchain architecture. Their goals are to optimize energy distribution and infrastructure upgrades, to protect local communities and economies during emergencies, to make clean, renewable electricity cost-effective, to provide infrastructure to support community involvement and to maximize circular economy benefits and foster job creation. The development of this architecture started in 2015, the programme was launched in 2016 in the form of a Microgrid in Brooklyn and to date comprises 60 connected sites.

E. SDG 8: Decent Work and Economic Growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

17. According to the ILO, 25 million people currently work under forced-labor conditions worldwide. SDG 8.7 urges immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour. To address this challenge, the U.S. State Department, jointly with CocaCola and the tech company The Bitfury Group, has initiated

a project involving the use of blockchain technology to create a secure registry for workers' legal status and their contracts. This is expected to aid in the fight against forced labour in global value chains by enhancing transparency and efficiency in the process of verifying compliance with labour policies throughout the chain.

18. Achieving decent work for all women and men, and equal pay for work of equal value is high on the agenda (SDG 8.5). In this regard, at a smaller scale, but at an implementation stage already, a blockchain application created to provide proof of living-wage payments to coffee growers is being led by Moyee Coffee, bext360 and the FairChain Foundation. In November 2017, a pilot project was launched in Ethiopia to ensure "fair and honest" supply of coffee beans, including "decent" working conditions for employees especially in the upstream part of the value chain. The platform gives all stakeholders, from farmers to consumers, access to relevant information across the supply chain, which brings a high degree of transparency and accuracy in real-time, with wage payment transactions visible within the blockchain.

F. SDG 9: Industry, Innovation and Infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

19. Efficient transportation services generate employment and wealth and drive economic development (E/2017/66). Target 9.1 advocates for the development of quality, reliable, sustainable and resilient regional and trans-border infrastructure to support economic development and human well-being. In this area, IBM Industry and Maersk have been collaborating since June 2016 in the creation of a platform that allows a more efficient and secure method for global trade. This platform for containerized shipping, through blockchain technology, is expected to reduce global trade barriers, bridging the existing gaps in information sharing in supply chains, guaranteeing visibility of shipment events in real time and fostering paperless trade. The platform is being tested now by selected partners including private enterprises such as Dupont and TetraPak, port and custom authorities such as Port Houston, Rotterdam Port Community System Portbase, the Customs Administration of the Netherlands and the U.S. Customs and Border Protection. Additional customs and government authorities have shown their interest in participating in the platform including the Singapore and Peruvian Customs agencies.

G. SDG 12: Responsible Consumption and Production - Ensure sustainable consumption and production patterns

20. SDG 12 aims at promoting more responsible consumption choices and production patterns. Therefore, important areas to address include sustainable business practices and consumer awareness and behaviour. In order to move in this direction, transparency and visibility of value chains and production processes are key steps for gaining a better understanding of the social, environmental and health risks and ensuring due diligence. Several private enterprises are focusing their efforts on achieving greater transparency and visibility into their supply chains and production processes. Hugo Boss, a fashion brand is developing a blockchain proof-of-concept in their cotton and leather supply chains, for example. The aim of this initiative is to support due diligence and compliance processes, by moving all existing transactions onto a permissioned blockchain, guaranteeing access to secure information by all partners. It also aims at providing the consumer with trusted and validated information about the origins of the cotton and leather products they purchase. This initiative is currently being studied by a group of experts from the Organisation for

Economic Cooperation and Development (OECD), in order to analyze its potential and scalability.

21. The tracking and tracing of food supply chains relates closely to consumers awareness on the origins of products and their health implications. SDG 12.8, for instance, specifically aims at ensuring that everyone has access to relevant information and awareness for sustainable development and lifestyles. In this connection, PricewaterhouseCoopers, Blackmores, Australia Post and Alibaba have teamed up in an anti-food fraud initiative for Australian food products being sold in China known as the "Food Trust Framework". The blockchain application aims at reducing fraud risks by increasing the transparency on the food supply chain. Taking into account the potential health risks related to manipulation of food supplies, food fraud is one of the biggest issues currently facing the global food industry.

H. SDG 16: Peace, Justice and Strong Institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

22. UNICEF recognizes there are approximately 230 million children around the world under the age of 5 which have not had their birth recorded. This places them at great risk for trafficking. As part of the "Blockchain4Humanity" initiative and supported by the World Identity Network (WIN), the United Nations Office for Project Services (UNOPS) and the United Nations Office of Information and Communication Technology (UN-OICT) launched a Global Challenge in January 2018. The purpose was to encourage the creation of blockchain application concepts and designs which could be later utilized and scaled up by the Government of Moldova, or other governments, in the fight to end child trafficking. The first prize was awarded to The Blockchain for Social Impact team of ConsenSys. They have developed an application which creates the possibility for giving unalterable identities to at-risk youth and others. In this way the guardians of these stakeholders and agents at border checkpoints are notified when these at-risk youth cross borders in order to more effectively protect them.

23. Further blockchain applications contributing to this SDG are also being developed such as trusted and transparent voting systems or projects aiming at enhancing security of digital public archives or records.

I. SDG 17: Partnerships for the goals - Strengthen the means of implementation and revitalize the global partnership for sustainable development

24. Target 17.10 and 17.12 of SDG17 on partnerships for the goals, are about promoting a universal, rules-based, open, non-discriminatory and equitable multilateral trading system, where processes are transparent, simple and contribute to facilitating market access, especially in support of least developed countries. Estonia, Finland, Latvia and Sweden are jointly developing a project under the European Union's Central Baltic interregional cooperation programme to create a blockchain-based application, to advance paperless trade, reduce time for cross-border transactions, simplifying trade processes and removing data duplications. Under the project, a logistical platform has been developed, SmartLog, which allows real-time monitoring of loading, customs processing and pre-shipment of export containers. With a budget of 2.4 million Euros, the platform is expected to be

launched by December 2019. A pilot has been carried out at the Muuga Harbour in Estonia and and the next one is planned for Finland.

IV. Further recommendations and conclusions

25. At present, the key question is how to bring this technology to maturity and develop applications with the critical mass needed for providing benefits at a global level and on a large scale. Building up the necessary ecosystems for engaging all stakeholders and developing necessary standards and resolving security issues are key pre-conditions for accelerating its adoption.

26. UNECE, with its UN/CEFACT, is working with a large team of experts, on the preparation of two white papers on blockchain technology for trade and economic development. These white papers will discuss the strategic use of blockchain to support trade facilitation; how existing UN/CEFACT standards could be used by blockchain application developers; and any new deliverables (or revisions of existing deliverables) that should be proposed.

27. To ensure wide dissemination of good practices, sharing of experiences and lessons learned, and to facilitate discussions on challenges and opportunities, international and/or regional platforms, such as annual Forums, could be established engaging all key actors and potential beneficiaries. This could be complemented with an online repository of use cases on blockchain applications to advance the SDGs.